### 5.6.3 Receiver Input Impedance

The control channel receiver of an AV device shall have an input impedance measured at the device media terminals greater than 20K ohms over the frequency range 1KHz to 50KHz. These conditions shall be met in the power-off condition and during power-on while in the INFERIOR state. This impedance is measured at the device control channel terminals with a sine wave amplitude of 500 mV p–p.

### 5.6.4 Noise Immunity Requirements

The receiver will successfully detect either the SUPERIOR or INFERIOR state during the state recognition time provided the respective state is present for a minimum of 90% of the required state recognition time. Figure 5.7 illustrates the two cases of noise rejection required during the SUPERIOR and INFERIOR state recognition time.

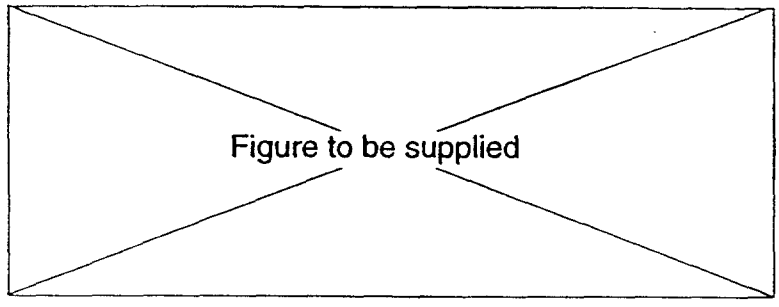


*Figure 5.7 Noise Immunity Requirements*

### 5.6.6 Receiver Fault Tolerance

The control channel receiver circuitry of the AV device should be able to tolerate the application of the following faults specified, and after the fault condition is removed, the operation of the receiver shall not be impaired.

- Input terminals shorted together (not touching control bus)
- Input terminals shorted together and shorted to either side of the control bus
- Input terminals shorted together and shorted to earth ground.
- The control bus shorted together while the device is properly connected

## 5.7 Data Channel Transmitter Characteristics

Any AV Bus data channel transmitter (both audio and video) is assumed to operate in one of two states: a low impedance active state in which signal is being applied to the medium; and a high impedance inactive state when no signal is being applied, and the device is either not powered, or in the receive mode of operation.

Only the transmitter and receiver parameters necessary to ensure electrical compatibility with other data channel devices, insure reliable data channel operation, and minimize media interference are specified in the following sections.

### 5.7.1 Audio Bus Transmitter

The following specifications apply to the interface of an audio device to the A1, A2, A3, and A4 media pairs. The interface requirements are identical for all audio media pairs. All parameters apply over the frequency range of 0 Hz to 20 KHz unless otherwise stated.

### 5.7.1.1 Active State

During the active, low impedance state the audio medium transmitter output impedance shall be 120 ohms ± TBD ohms between the audio medium connector pins. Output impedance shall be 60 ohms ±TBD ohms between each audio medium connector pin and the CMR line.

The *maximum*?? differential output voltage amplitude (Vdif) at the audio medium connector, driving the test circuit of Figure 5.8 in either switch position, will be 2V RMS.

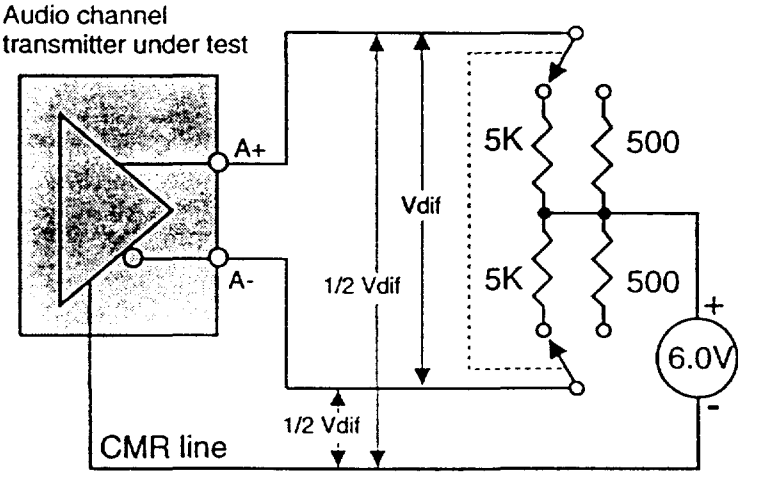


*Figure 5.8 Audio Channel transmitter test circuit*

The gain symmetry of all audio medium transmitters between audio medium lines will be less than 1% from DC to 20 KHz when driving the test circuit of Figure 5.8.

### 5.7.1.2 Inactive State

During the inactive, high impedance state the audio media transmitter circuit should maintain an output impedance between 10K ohms and 1M ohms. The output impedance should be between 5K ohms and 1M ohms between each audio medium connector pin and the CMR line. There will be less than 30µV p-p?? output signal into a 10K ohm load, at any frequency during the inactive state.

### 5.7.1.3 Common Mode Output Voltage

The magnitude of the common mode output voltage (Vcm) of the audio medium transmitter, in either the active or inactive state, measured between the midpoint of a test load shown in Figure 5.9 and the CMR line, shall be 6.0 V ±TBD volts.

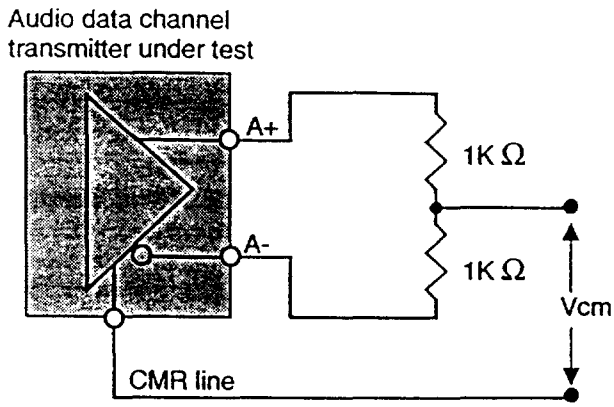


*Figure 5.9 Audio Common Mode Output Test Circuit*

#### 5.7.1.4 DC Offset Voltage

The magnitude of the audio medium transmitter DC offset voltage, measured across the audio medium connector pins with a 10K ohm load, in either the inactive state or active state with no input signal, shall be less than ±TBD volts.

The change in the DC offset voltage while transitioning from the inactive state to the active state shall be less than ±TBD volts.

### 5.7.2 Video Bus Transmitter

The following specifications apply to the interface of a video device to the V1, V2, V3, and V4 medium pairs. The interface requirements are identical for all video media pairs. All parameters apply over the frequency range of 0Hz to 5.0MHz.

#### 5.7.2.1 Active State

During the active, low impedance state the video medium transmitter output impedance shall be 120 ohms ± TBD ohms between the video medium connector pins. Output impedance shall be 60 ohms ±TBD ohms between each video medium connector pin and the CMR line.

The *maximum*?? differential output voltage amplitude (Vdif) at the video medium connector, driving the test circuit of Figure 5.8, will be 1 volt p-p ±TBD volts.

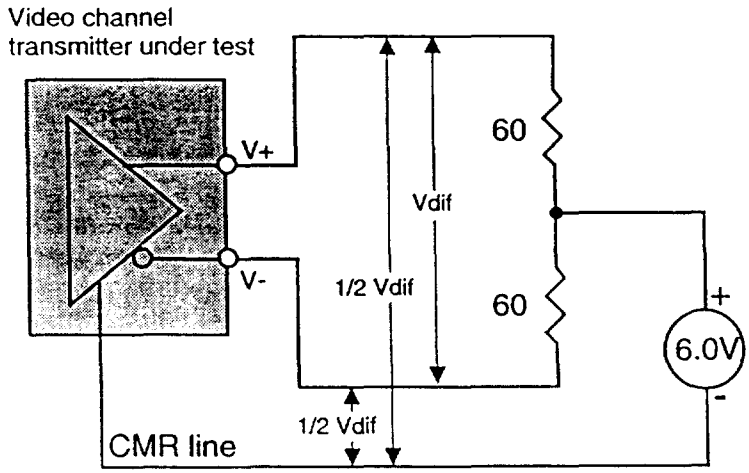


*Figure 5.10 Video Channel transmitter test circuit*

The gain symmetry of all video medium transmitters between video medium lines will be less than 1% from DC to 20 KHz when driving the test circuit of Figure 5.10.

### 5.7.2.2 Inactive State

During the inactive, high impedance state the video media transmitter circuit should maintain an output impedance between 3K ohms and 1M ohms. The output impedance should be between 1.5K ohms and 1M ohms between each video medium connector pin and the CMR line. There will be less than 30µV p-p?? output signal into a 60 ohm load, at any frequency during the inactive state.

### 5.7.2.3 Common Mode Output Voltage

The magnitude of the common mode output voltage (Vc) of the video medium transmitter, in either the active or inactive state, measured between the midpoint of a test load shown in Figure 5.11 and the CMR line, shall be 6.0 V ±TBD volts.

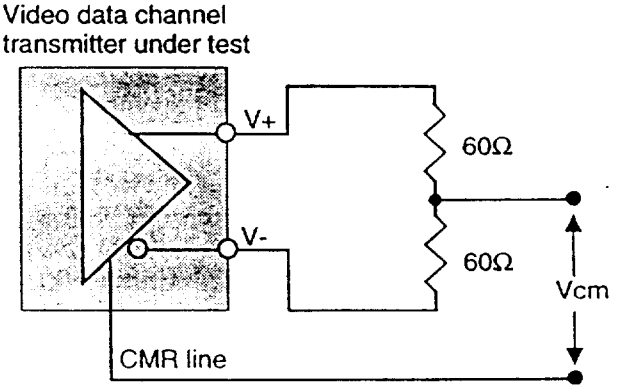


*Figure 5.11 Video channel common mode output test circuit*

### 5.7.2.4 DC Offset Voltage

The magnitude of the video medium transmitter DC offset voltage, measured across the video medium connector pins while connected to the test circuit of figure 5.10, in either the inactive state or active state with a 30 IRE input signal, shall be less than ±TBD volts.

The change in the DC offset voltage while transitioning from the inactive state to the active state shall be less than ±TBD volts.

### 5.7.3 Data Channel Transmitter Fault Tolerance

Any audio or video transmitter, while in either the active or inactive state, shall tolerate the application of each of the following faults indefinitely; and after the fault condition is removed, the operation of the driver shall not be impaired. In addition, the magnitude of the sink or source current from the driver under any of the fault condition specified shall not exceed 10mA.

- Output terminals shorted together (not touching medium).
- Output terminals shorted together and shorted to either or both conductors of the medium pair.
- Either or both output terminals shorted to CMR line.

## 5.8 Data Channel Receiver Characteristics

Any AV Bus data channel receiver on any AV media (both audio and video) is assumed to operate in a high impedance state. The following specifications must be meet while the device is connected to the media.

Only the receiver parameters necessary to ensure electrical compatibility with other data channel devices, insure reliable control channel operation, and minimize media interference are specified in the following sections.

### 5.8.1 Audio Bus Receiver

The following specifications apply to the interface of an audio receiving device to the A1, A2, A3, A4 pairs. The interface requirements are identical for all audio media. All parameters apply over the frequency range of 0 Hz to 20 KHz unless otherwise stated.

#### 5.8.1.1 Audio Channel Input Impedance

The audio medium receiver shall have an input impedance, measured at the device audio media terminals, between 10K ohms and 1M ohms. The input impedance shall be between 5K ohms and 1M ohms between each audio medium connector pin and the CMR line. These conditions shall be met in the power-off or power-on condition. This impedance is measured at the audio medium terminals of the AV Bus connector with a differential sine wave amplitude of 1.0V p–p??.

#### 5.8.1.2 Received Signal Conditions

The audio medium receiver shall operate normally with a received signal range of 2.0 volts RMS maximum while in the presence of a common mode voltage of 6.0 volts ±TBD volts from either audio terminal to reference GND (as shown in Figure 5.12), and a DC offset voltage of ≤ ±TBD between audio terminals.

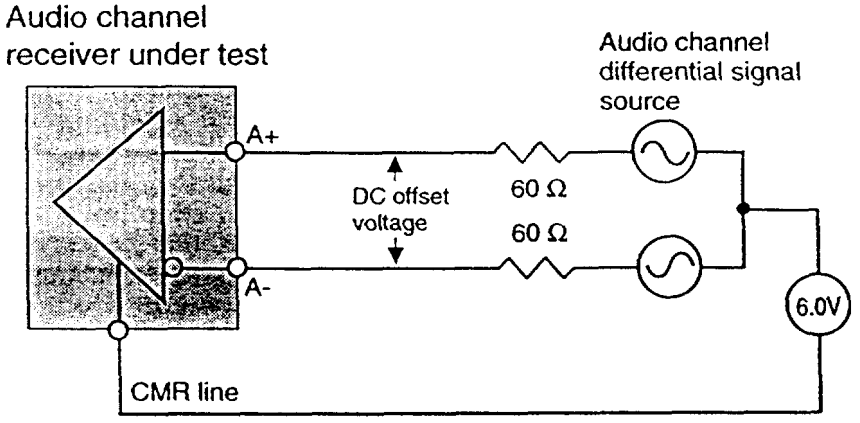


*Figure 5.12 Audio receiver common mode test circuit*

#### 5.8.1.3 Common Mode Rejection Ratio

The audio receiver will have a common mode rejection ration ≥ 60 dB measured at 20 KHz.

#### 5.8.1.4 Media Isolation

Any audio medium receiver will provide a minimum of 80dB of signal isolation between the connected medium and all other AV bus media and all other non-AV bus signals in or out of the AV device.

5.8.2 Video Bus Receiver
The following specifications apply to the interface of a video receiving device to the V1, V2, V3, and V4 pairs. The interface requirements are identical for all video media. All parameters apply over the frequency range of 0 Hz to 5.0 MHz unless otherwise stated.

**5.8.2.1 Video Channel Input Impedance**
The video medium receiver shall have an input impedance, measured at the device video media terminals, between 3K ohms and 1M ohms. The input impedance shall be between 1.5K ohms and 1M ohms between each video medium connector pin and the CMR line. These conditions shall be met in the power-off or power-on condition. This impedance is measured at the video medium terminals of the AV Bus connector with a differential sine wave amplitude of 1.0V p–p??.

**5.8.2.2 Received Signal Conditions**
The video medium receiver shall operate normally with a received signal range of 1.0 volts p-p maximum while in the presence of a common mode voltage of 6.0 volts ±TBD volts from either video terminal to reference GND (as shown in Figure 5.13), and a DC offset voltage of ≤ ±TBD between video terminals.

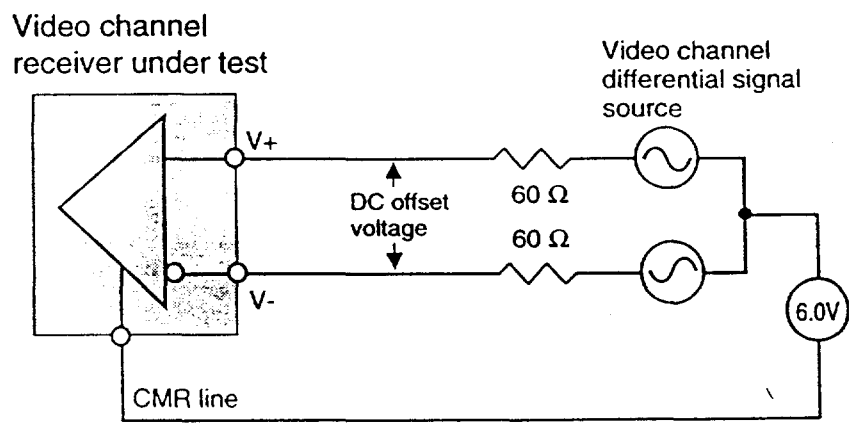


*Figure 5.13 Video receiver common mode test circuit*

**5.8.2.3. Common Mode Range**
The video receiver will have a common mode rejection ration ≥ 35 dB measured at 4 MHz.

**5.8.2.4 Media Isolation**
Any video medium receiver will provide a minimum of 80dB of signal isolation between the connected medium and all other AV bus media and all other non-AV bus signals in or out of the AV device.

## 5.9 Common Mode Reference Line
The common mode reference line medium contacts of each AV device will be internally connected together and will connect to the device circuit common through an internal series resistance of 100 ohms??

## 5.10 Device Failure Modes
Detecting the cause of a bus failure due to a failing device or bad connection is very difficult in a bus where all devices are connected in parallel. For this reason, extra precaution should be taken to insure the design of each device meets the required failure mode specifications.

### 5.10.1 Electrical Failure

A device which experiences an electrical failure to render the device inoperative should fail in an INFERIOR state on the bus. No device failure will leave the control channel Physical Layer in a low impedance state on the bus.

### 5.10.2 Control Channel Jabber Inhibit

The control channel Physical Layer of each device shall contain a jabber inhibit section which shall monitor the length of time the transmitting element is active. If a node asserts the SUPERIOR state continuously for a period longer than 1000 unit symbol times then the node must disconnect from the network or revert to a state equivalent to the INFERIOR state for a period greater than 10 seconds before attempting to re-connect The jabber inhibit shall then resume monitoring. This sequence may then be repeated..

# 6 AV Media Node 0 Requirements

## 6.1 Control Channel Routing

A Control channel router device may be attached to the AV network for routing of control channel messages to any other media including additional AV networks. A router device must meet all Physical Layer requirements of an AV device as described in section 5 of this document. Complete specifications for CEBus control channel router devices are given in IS-60.03 Part 8.

A router may attach to the AV network at any point using a network connector. It may exist as a separate device or may be built into an AV device.

## 6.2 Data Channel Bridging

AV data channels may be bridged between AV media on two different AV networks, or between AV media and another CEBus media (PL, CX, etc.). A data channel bridge must meet all data channel Physical Layer requirements of an AV device and must meet all signal frequency and level requirements for the data channels it bridges on each media. Complete specifications for data channel bridges are given in IS-60.03 Part 8.

A data channel bridge may attach to the AV network at any point in the network using a network connector. It may exist as a separate device or may be built into an AV device.

# REFERENCES

# Scope of FCC's Standardization Authority Under the 1992 Cable Act

This document summarizes the scope of the Federal Communications Commission's ("FCC") standardization authority under the Cable Act of 1992. Specifically, the analysis addresses whether the Cable Act gives the FCC the regulatory authority to go beyond the adoption of compatibility standards for cable systems, televisions and video cassette recorders ("VCRs") to include interface or protocol standards for home automation communications.

## SUMMARY

Under the Cable Act of 1992, the Commission's standardization authority is limited to the adoption of a compatibility standard for cable systems, televisions, and VCRs for the encoding of television programming. The current EIA/NCTA proposal in ET Docket No. 93-7 for the FCC to include the CEBus home automation protocol (EIA IS-60) as part of the its Cable Act compatibility standard is clearly beyond the scope of Congress's mandate.

## DISCUSSION

Under Section 17 of the Cable Act, entitled "Consumer Electronics Equipment Compatibility," Congress directed the FCC to issue regulations

> assuring compatibility between televisions and video cassette recorders and cable systems, consistent with the need to prevent theft of cable service, so that cable subscribers will be able to enjoy the full benefit of both the *programming* available on cable systems and the *functions* available on their televisions and video cassette recorders.

47 U.S.C. § 544a(b)(1)*(emphasis added)*. This and other relevant portions of the Act and its legislative history are attached.

The compatibility provision was designed to combat two problems concerning television programming. First, Congress recognized that cable operators' encryption of their programming through cable converters (or "set-top boxes") disabled the special

features and functions in televisions and VCRs for which consumers were paying a premium. Second, as monopolists, cable operators designed their cable systems in such a way that programs could only be descrambled through set-top boxes purchased or leased from the operator. Because converter boxes are technologically required in order to decode "scrambled" cable programming, consumers therefore had no choice of converter equipment and confronted incompatibilities between "cable ready" televisions and their set-top boxes.

In furtherance of these two objectives, Congress charged the Commission with identifying and implementing a compatibility standard to provide for the interoperability among television equipment so that consumers would be able to pick and chose the descrambling devices they wanted. The text of the standardization provision makes clear that the FCC's authority is to be used for assuring compatibility of equipment for purposes of reception of television "programming." Moreover, under Section 17 the FCC was also required to determine whether, and if so how, cable operators should be restricted in the encryption of cable signals. As in the provision on equipment compatibility, Congress linked scrambling to the protection of the features and functions of television sets. The section specifically states:

> the Commission shall determine whether and, if so, under what circumstances to permit cable systems to scramble or encrypt signals or to restrict cable systems in the manner in which they encrypt or scramble signals, except that the Commission *shall not limit the use* of scrambling or encryption technology where the use of such technology *does not interfere* with the functions of subscribers' television receivers or video cassette recorders. 47 U.S.C. § 544a(b)(1) *(emphasis added).*

For both of these provisions, the equipment "functions" with which Congress wanted to eliminate interference from the converter included the ability to tape a program on one channel while watching another channel, to use the VCR to tape two consecutive programs on different channels, and to use advanced television picture generation and dis-

play features (such as picture-in-picture, etc.). Thus, all of the "functions" referred to in the Cable Act relate directly to *programming capabilities* of television equipment.

The remaining portions of Section 17 support the conclusion that the "Consumer Electronics Equipment Compatibility" provisions are designed to provide for interoperability among televisions, VCRs, converter boxes and remotes for the transmission and descrambling of television programs. There are five specific requirements for FCC action in Section 17, none of which extends beyond television equipment or the encryption of television programming. Congress instructed the Commission to promulgate regulations identifying the technical requirements for TVs and VCRs to be labeled as "cable ready." 47 U.S.C. § 544a(c)(2)(A).[1] These regulations also must ensure that cable operators utilizing converters (i) notify consumers that their television and VCR features could be disabled, and (ii) give consumers a choice of having all non-encrypted channels delivered directly to their television or VCR without passing through the converter. Id. § 544a(c)(2)(B). Third, the regulations must promote the "commercial availability" from unaffiliated vendors of converters and remote control devices compatible with the converters. Id. § 544a(c)(2)(C). Fourth, cable operators must notify consumers that they can also purchase compatible remotes from unaffiliated vendors. Id. § 544a(c)(2)(D). Finally, the regulations must ensure that cable operators cannot prevent their own converters from operating with other commercially available remotes. Id. § 544a(c)(2)(E).

Thus, the purpose, text and structure of Section 17 all indicate that Congress directed the FCC to standardize equipment compatibility for purposes of descrambling of cable television programming and ensuring that descrambling technology (*i.e.*, converters) does not interfere with other functions of television equipment. Nothing in the leg-

[1] The Conference Report defined the purpose of the "cable ready" provision as "to make clear what standards need to be met, consistent with and in conformity to the compatibility regulations issued pursuant to subsection (b)(1), in order for televisions or VCRs to be sold as cable ready or cable compatible."

islative history of the Cable Act, including the virtually identical prior versions of the Act or the text of Section 17 itself, indicates that Congress intended the Commission's regulations to go beyond ensuring consumers that their television and VCR equipment is interoperable with converters available from an array of competing vendors. There certainly is nothing suggesting that the scope of the Commission's authority extends beyond television programming, equipment and interoperability for purposes of descrambling, or for technologies unrelated to television programming, such as home automation or other non-video technology.

The limited scope of the "Consumer Electronics Equipment Compatibility" provisions of the Cable Act is apparent from the explanation offered by Senator Leahy, the original sponsor of the provision. As Senator Leahy explained when introducing his amendment:

> [T]he main thing that the absence of competition allows a monopoly to do is ignore the best interests of its customers. But when the consumer is captive, monopolies can do what is best for monopoly and let the consumer be damned.
>
> My amendment is designed to create more user-friendly connections between cable systems on the one hand and televisions and VCRs on the other so that consumers will actually get to use the TV and VCR features they paid for.
>
> It would direct the FCC, in consultation with representatives of the cable and consumer electronics industry to devise a means of assuring that cable systems and televisions and VCRs will connect in a compatible manner that allows consumers to get the benefit of the programming available on cable and the features available on televisions and VCRs. 138 Cong. Rec. S561-02.

Thus, from the inception, the standardization power granted to the FCC was clearly limited to that necessary to ensure technical compatibility of descrambling converters and to eliminate interference between set-top devices and the special video features of television and VCR equipment, both of which are designed to deliver descrambled cable programming to consumers through interoperable video equipment from multiple manufacturers.

The only language that might suggest that the scope of the Commission's standardization authority may be any broader is the last portion of Section 17. This provision requires the Commission to periodically review its regulations to account for improvements and changes in the cable system, TVs, VCRs and "similar technology." 47 U.S.C. § 544a(d). However, "similar technology" plainly does not include technologies, such as home automation, that are unrelated to video or television programming. Home automation is not a special "feature" or "function" of televisions and VCRs and, indeed, is technically independent of television programming. Thus, home automation is not "similar technology" and is outside the scope of the Commission's standardization mandate.

Moreover, the current EIA/NCTA proposal to include the CEBus home automation protocol as part of the FCC's compatibility regulations will affect the very results the Cable Act was designed to avoid. Under the Commission's proposed standard, consumers would be unable to use the home automation protocol of their choice because the inclusion of CEBus would exclude other home automation technologies. Thus, just as Congress wanted to ensure that consumers were not captive to a single descrambling technology unilaterally chosen by their cable operator, adopting the EIA/NCTA proposal would improperly use the Cable Act to dictate a single home automation technology.

## CONCLUSION

Given the specific statutory language and the consistent legislative history, it is plain that Congress intended to limit the Commission's standardization authority to promulgating regulations that would allow for interoperability of cable converters, televisions and VCRs, commercially available from multiple vendors, for the descrambling of television programming, without interfering with the programming features of consumer video electronics. The Commission's implementation of a cable compatibility

standard including anything beyond this, such as the CEBus home automation protocol, is inconsistent with its statutory mandate under the 1992 Cable Act.

Attachments